

Western Electric Co., Incorporated,
Equipment Engineering Branch, Hawthorne

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Issue 3 BT-207867
April 2, 1930.
Replacing all previous
issues.

This Method of Operation was prepared from Issue 23 of Drawing ES-207867.

METHOD OF OPERATION
Miscellaneous Tone and Interrupter Circuits - Panel System

DEVELOPMENT

1. PURPOSE OF CIRCUIT

1.1 This circuit shows miscellaneous tone, interrupter and tone alarm circuits required for use in panel offices.

2. WORKING LIMITS

2.1 None.

OPERATION

3. PRINCIPAL FUNCTIONS

3.1 Provision of flashing interrupters for:

3.11 Line busy.

3.12 All incoming local paths busy.

3.13 All incoming toll paths busy.

3.2 Provision of tone for:

3.21 Busy.

3.22 All paths busy.

3.23 Dial.

3.24 Permanent signal.

3.25 Howler.

3.26 Check.

3.27 Trunk assignment.

3.3 Provision of alarms for:

3.31 Ground and line busy circuit.

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issues.

3.32 No voltage for busy, all paths busy and dial tones.

4. CONNECTING CIRCUITS

4.1 This circuit connects with any panel system circuit requiring the various interrupter frequencies and tones.

DESCRIPTION OF OPERATION

5. LINE BUSY INTERRUPTERS

This interrupter causes periodical interruption of the busy tone applied by panel selector circuit. A ground on any of the associated line busy leads "D" will cause operation and release of relay (BB) in unison with the make and break of the interrupter, causing lamp (BB) to flash. Relay (BB) also controls the relay in the associated fuse alarm circuit which, alternately operating and releasing, operates alarms at the alarm boards.

6. ALL PATHS BUSY FLASH

This circuit furnishes interrupted ground over lead "PB" for operating and releasing the supervisory relay in an incoming circuit from manual key indicator system. This relay, in turn, causes the "A" operator's supervisory lamp to flash as an indication that the incoming has gone to overflow. Interrupted ground is furnished over lead "PBI" to operate and release a relay in the toll key indicator incoming circuit for flashing the toll supervisory lamp to indicate that the incoming has gone to overflow.

7. TONES

The busy tone and all paths busy tone leads supply the same low tone except that the all paths busy tone is periodically connected and disconnected by the interrupter. A different low tone is provided for dial tone. High tone, either direct or through a repeating coil is furnished for permanent signal, howler, check and trunk assignment.

8. ALARMS

Relays (LT1) and (LT2) provide an alarm for the busy tone, all paths busy tone and dial tone circuits. These relays are normally held operated by interrupter battery through a low tone commutator. Relay (R) (Fig. 5) provides an alarm for the dial tone when ringing current is superimposed upon dial tone to prevent interference with the tone by contact resistance. In case the ringing current is disconnected, relay (R) releases causing operation of visible and audible signals. Where

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the location of the ringing machine equipment is remote from that of the main power equipment. Fig. 2 is used to provide alarms both in the alarm board for the floor on which the ringing machine is located and in the power alarm cabinet.

9. PERMANENT SIGNAL TONE

When the associated key at the sender monitor position is operated, tone is connected to the high winding of output transformer (PST) of Fig. 4. This causes high tone to be applied over lead "I" to the ring of each holding line for permanent signals for identifying defective cable pairs.

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Printed in U.S.A.

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Issue 1 BT-207959
July 5, 1938

This Method of Operation was prepared from Issue 14 of Drawing ES-207959.

METHOD OF OPERATION

Panel System - Final Circuit - With Marginal Relay Test Circuit -
Arranged for Routine Testing of Subscriber Lines

DEVELOPMENT

1. PURPOSE OF CIRCUIT

This circuit is for the purpose of completing connections from a manual or panel type office to a subscriber's individual or PBX line in a ground cut-off relay panel office.

2. WORKING LIMITS

- 2.1 The maximum external circuit subscribers loop resistance is 750 ohms with "Y" wiring and 1500 ohms with "Z" wiring.
- 2.2 The minimum subscribers line insulation resistance for item 2.1 is 10,000 ohms.
- 2.3 The maximum external circuit loop resistance for selections is 1474 ohms with minimum trunk insulation resistance 30,000 ohms.

OPERATION

3. PRINCIPAL FUNCTIONS

This circuit is used to establish a connection from the incoming selector multiple to a subscriber's or P.B.X. line. Its principal functions are:-

- 3.1 Selection of desired line, distinguishing between direct and P.B.X. lines, and establishing talking connection
- 3.2 Testing called line for busy and, if busy individual line, returning selector to normal
- 3.3 Transmitting busy signal to calling station
- 3.4 Holding of line busy to other hunting selectors
- 3.5 Disconnection after conversation
- 3.6 Tell-tale, "no test", and premature release features
- 3.7 Private automatic exchange (PAX) station selections
- 3.8 Routine testing of subscribers' lines

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3.9 Arranged for testing subscribers' lines from the test desk

4. CONNECTING CIRCUITS

This final functions with the following:

4.1 Line switch and line finder line circuits

4.2 Regular local, cordless and inter-office incoming selector circuit

4.3 Standard two and three digit senders, cordless sender selector circuits and cordless senders

4.4 Five hundreds test selector

DESCRIPTION OF OPERATION

5. SEIZURE

When an incoming selector seizes the tip, ring and sleeve terminals of this circuit, ground in the incoming is connected to the sleeve terminal, making this circuit test busy to other hunting incoming selectors, and the incoming advances to the selection beyond position. With the incoming in selection beyond position, the final L relay operates over the fundamental circuit in series with the stepping relay in the sender. The L relay operated, operates the TK relay. The TK relay operated, locks to ground on the sleeve of the associated incoming selector circuit and advances the switch to position 2.

6. BRUSH SELECTION

With the switch in position 2, the high speed updrive magnet (HS) operates, causing the selector to move upward for brush selection. As the selector moves upward, carrying the commutator brushes over the commutator segments, the A segments and brush intermittently connect ground through to the tip side of the fundamental circuit, alternately closing and opening a short circuit around the stepping relay in the associated sender circuit, thus releasing it and permitting its reoperation. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened by the sender, releasing the L relay and consequently opening the circuit through the (HS) magnet, which stops the upward movement of the selector, and the switch advanced to position 3.

7. GROUP SELECTION

In position 3, when the fundamental circuit is closed by the sender, the L relay operates, advancing the switch to position 4. The (HS) magnet is now operated and the selector moves upward for group selection.

The trip magnet being operated in position 3 to 5, the previously selected set of brushes is tripped as the selector moves upward in position 4. Also as the selector moves upward, the B commutator segments and brush intermittently connect ground to the tip side of the fundamental circuit, alternately closing and opening a short circuit around the stepping relay in the associated sender circuit, thereby releasing and permitting the reoperation of the stepping relay until sufficient impulses have been sent back to satisfy the sender. The fundamental circuit is then opened by the sender, releasing the L relay, which opens the circuit through the (HS) magnet, stopping the upward movement of the selector, and advances the switch to position 5.

8. UNITS SELECTION

When the fundamental circuit is closed through in the sender, the L relay operates, advancing the switch to position 6. The low speed (LS) magnet operates, causing the selector to move upward, and U commutator brush and segments function the same as the A commutator brush and segments as described previously. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened, releasing the L relay. The release of the L relay opens the circuit through the LS magnet, stopping the selector brushes on the tip, ring and sleeve terminals of the called line and advances the switch to position 7, the A cam advancing it to position 9. When in position 6-3/4, the P.B.X. relay is connected in parallel with the 40 ohm resistance to the ring, but it does not operate due to the high resistance to battery in the incoming circuit. As the switch advances beyond position 8-1/2, ground is disconnected from the ring permitting the associated incoming circuit to advance.

9. INDIVIDUAL LINE OR FIRST LINE OF A P.B.X. GROUP NOT BUSY

With the switch in position 9, the L relay operates through its primary winding, advancing the switch to position 10, the A cam advancing it to position 12. As the switch leaves position 11, the L relay releases, connecting battery through the two 110 ohm resistances to the S terminal to operate the cut-off relay in the line circuit. The release of the L relay also advances the switch to position 13, ground from the armature of the TK relay advancing the switch to position 14 and ground through the break contact of the L relay advancing the switch to position 15. As the switch passes through position 13-1/2, ground through cam I is connected to the selector group register circuit, operating that register.

10. DISCONNECTION

When the associated incoming selector advances from the talking position, ground is disconnected from the sleeve terminals, releasing the TK relay. The TK relay released, operates, the L relay through its secondary winding, advancing the switch to position 16. In position 16, the L relay holds through its primary winding over the loop to the called

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station. In position 16, the 18-AC 500 ohm resistance is connected across the primary winding of the L relay, which still holds, this parallel combination being for the purpose of aiding the release of the L relay when the receiver is replaced on the switchhook at the called station. In position 16, with "L" wiring, ground is connected through the D cam to the selector time alarm circuit which operates if the switch remains in position 16 for an abnormal length of time. When the receiver is replaced on the switchhook at the called station, the L relay releases and advances the switch to position 17. With "M" wiring the selector time alarm circuit will cause automatic release of the final even if the called party has the receiver off the switchhook. Ground on the armature of the TK relay advances the switch to position 18, where the DOWN magnet operates, moving the selector downward. When the selector reaches normal, ground through the Y commutator advances the switch to position 1, releasing the DOWN magnet.

11. NO TEST

On calls from a cordless position, when the "No Test" key is operated, the circuit functions as described in paragraphs 5 to 8 until the switch reaches position 6-3/4 when battery through a low resistance in the cordless sender selector circuit is connected to the ring-side of the fundamental circuit, operating the P.B.X. relay. The P.B.X. relay operated, releases the TK relay, which advances the switch from positions 8 to 13 without testing the called line for busy or waiting for P.B.X. hunting. The release of the TK relay connects ground to the sleeve of the incoming circuit to keep it busy. As the switch leaves position 8-1/4 the P.B.X. relay releases. Since the TK relay is released, the L relay does not operate in position 9 as described in paragraph 9. In position 13, the TK relay operates and locks through its primary winding, advancing the switch to position 14. Since the L relay is normal, the switch advanced to position 15 immediately. Disconnection takes place in the same manner as described in paragraph 10.

12. BUSY INDIVIDUAL LINE

In case the called line is an individual line and is busy, the circuit functions as described in paragraphs 5 to 8 until the switch enters position 11. In position 11 high potential battery on the S terminal operates the P.B.X. and TB relays in series. The TB relay operated, holds the L relay operated through its primary winding, and the P.B.X. relay operated, releases the TK relay. The TK relay released, advances the switch to position 13. When the switch leaves position 12-1/2, the P.B.X. and TB relays release, but the L relay holds through its secondary winding. In position 13, the TK relay operates and locks to ground in the associated incoming selector, advancing the switch to position 14, where the DOWN magnet operates, restoring the selector to normal. When the selector reaches normal,

ground on the Y commutator segment advances the switch to position 17. In position 13 to 14, the TRIP magnet operates but does not perform any useful function at this time. In position 17, a circuit is closed from interrupted ground over lead D from the busy flash interrupter through cam P to operate and release the L relay as controlled by the interrupter. The operation of the relay closes a circuit from lead B of the miscellaneous tone and interrupter circuit to the ringside of the trunk, thereby giving a busy back tone to the calling subscriber. When the calling subscriber or operator disconnects, the associated incoming selector advances to remove ground from the sleeve terminals, thus releasing the TK relay. The release of the TK relay advances the switch to position 18 where ground on the Y commutator advances it to normal.

13. P.B.X. HUNTING

If the line on whose terminals the selector brushes rest at the end of units selection is the first of a group of P.B.X. lines, and one or more of this group is busy, when the switch reaches position 11 low potential battery on the S terminal operates the TB relay but not the P.B.X. relay. The TB relay operated, holds the L relay and as the switch enters position 12 the LS magnet operates, causing the selector to move upward. When an idle terminal is reached, ground potential on the S lead, releases the TB relay, opening the holding circuit through the primary winding of the L relay, which however holds through its secondary winding to ground on the C commutator. The adjustment of the C commutator brush with relation to the tripped sleeve multiple brush is such that it does not break contact with the C commutator segment until slightly after the holding circuit through the winding of the TB relay is opened at the time that the sleeve brush breaks contact with the busy terminal and makes contact with the sleeve terminal of an idle line. The L relay and the LS magnet therefore remain operated and the selector continues to travel upward until the C commutator brush breaks contact with the metal segment. At this time, the brushes are slightly above the center of the selected terminals and a locking pawl enters the notch of the rack attached to the brush support rod. With the circuit to ground on the C commutator opened, the L relay releases, disconnecting ground from the commutator feed bar (G) and releasing the LS magnet. The selector then drops back against the locking pawl, thus centering the brushes on the line terminals. During P.B.X. hunting, ground is connected to the G commutator through cam D from and under control of the L relay. This is to prevent the reoperation of the L relay by the closing of a circuit from ground through the C commutator brush and segment as the selector drops into place. The release of the L relay also advances the switch to position 13. From this point on the circuit functions as previously described in par. 9 and 10. If the last line of a P.B.X. group is reached, since the sleeve condition is the same as for an individual line, the TB relay releases in position 12 if the line is idle or the P.B.X. relay operates in position 12 if the line is busy and the circuit functions from here the same as described for an individual line.

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14. P.A.X. DIALING

When the office in which this final circuit is located has lines terminating in private automatic exchanges, this final circuit is arranged with "X" wiring. In this case, ground, is connected to the ring side of the trunk until the switch advances from position 14-1/2 to hold the incoming selector in the "Selection Beyond" position. This circuit then functions as under an "Individual Line" to connect to the line, where ground on the ring of the P.B.X. trunk holds the incoming in the selection beyond position until all selections have been completed. This circuit is in talking position when P.A.X. selections take place. Disconnection is the same as for an individual line.

15. PREMATURE RELEASE

Should the calling subscriber replace the receiver on the switch-hock or the cordless operator depress the disconnect key before the final switch advanced from position 14, the incoming selector functions and removes the ground from the sleeve, releasing the TK relay. The TK relay released, advances the switch from any position between 1 and 13 to position 13, where the TK relay operates and advances the switch to position 14. The TK relay now releases, in turn operating the L relay through its secondary winding which operates the DOWN magnet, restoring the selector to normal. In position 13 to 14, the TRIP magnet is energized so that in case this premature release starts before the final has advanced beyond brush tripping tone, the trip finger shall not be in the way of the returning selector brushes. When the selector reaches normal, ground on the Y commutator brush and segment advances the switch to position 17, ground on the armature of the TK relay advancing the switch to position 18 and ground on the Y commutator, advancing it to normal.

16. TELL TALE

Should the selector travel to the top of the frame, "Tell Tale" position, during selection in position 2, 4, 6 or 12, ground on the X commutator brush and segment advances the switch to position 13. The switch now advances to position 15, and awaits the advance of the incoming circuit to release the TK relay. From this point the circuit is returned to normal as described in paragraph 10.

17. ROUTINE TESTING OF SUBSCRIBER'S LINE

When used with the subscriber's line test set, jack T-1 and T-2 of this circuit are connected to the corresponding jacks of the test set by patching cords. The final selector is held busy during the test period by ground in the test set over the sleeve of jack T-1. The fundamental circuit is closed through the tip of jack T-1. The circuit functions under control of the test set as previously described

on a regular call until the L relay releases after completing units selection. The release of the L relay does not advance the switch from position 6 and in position 6, the tip, ring and sleeve brushes rest on the terminals of the line to be tested, the sleeve brush being connected through the sleeve of jack T-2 to battery in the test set, thus holding the selected line busy. The line is then tested through the tip and ring of jack T-2. All the lines in the final selector multiple bank may be tested in rotation. The operation of a "stepping key" in the test set closes the fundamental circuit through jack T-1, operating the L relay. The L relay, operated, operates the LS magnet, moving the selector brushes up to the next set of line terminals. The test set opens the fundamental circuit when the selector reaches the next set of terminals, releasing the L relay and the LS magnet. To reset the selector to test another group of lines or to restore the circuit to normal, the disconnect key in the test set is operated, removing ground from the sleeve of jack T-1, thus releasing the TK relay. The TK relay released, advances the switch to position 13. In position 13, the TK relay operates, advancing the switch to position 14, where the TK relay releases. This circuit returns to normal as described in paragraph 15.

18. TESTING SUBSCRIBERS' LINES FROM THE TEST DESK

When provision is made to test the subscriber's line circuits from the test desk, relay (SC) is provided and "V" wiring is used. When the final selector has advanced to position 15, the operation of a key at the test desk causes ground to be connected to the SC lead operating the (SC) relay. The operation of the (SC) relay opens the locking circuit of the (L) relay through the subscribers loop, to allow the final to advance on disconnect, regardless of whether or not the called subscriber is on the line and releases the (CO) relay of the subscriber's line circuit which in turn causes the (L) relay of the line circuit to operate and start a line finder hunting for this line. When the line is found by the line finder, a check for dial tone is obtained at the test desk. The purpose of this test is to determine whether the subscriber's line is seized by a line finder and whether dial tone is applied to the line.

19. TEST JACK

Jack (TMB) is used to test the operation of this circuit and to make the circuit busy to other hunting selectors.

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Issue 1 BT-207959
May 1, 1939
Appendix 1

This Appendix was prepared from Issue 15 of Drawing ES-207959

METHOD OF OPERATION

Panel System - Final Circuit - With Marginal Relay Test Circuit - Arranged
For Routine Testing Of Subscriber Lines

1. PURPOSE OF CIRCUIT

Add: The release on "No Test" calls is under control of the calling end. Jacks are provided whereby subscribers lines may be tested.

3.7 Change to read, "Can be arranged for automatic release in await called subscriber release position.

10. Change sentence starting, "With "M" wiring the selector time alarm, etc" to read "When "M" wiring is used, the holding circuit for the (L) relay in position 16 is opened by the operation of a relay in the selector time alarm circuit after a definite time interval, so that the selector advances from position 16 and restores to normal as described above even though the called subscriber has not replaced his receiver on the switchhook". Add, "When "T" wiring and the associated apparatus is provided, the trip magnet is operated in positions 17 1/2 to 18 to prevent snagging of the brushes during the return of the selector".

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